

WHAT IS CLAIMED IS:

- 1 1. A pressure regulating valve for regulating a pressure of
2 fluid to be outputted from the pressure regulating valve, the
3 pressure regulating valve comprising:
 - 4 a valve body having a cylinder, a supply passage which
5 fluidly communicates the cylinder and a fluid pressure supply
6 source, and a drain passage which fluidly communicates the
7 cylinder and a sump;
 - 8 a spool slidably disposed in the cylinder with a clearance,
9 the spool being made of a material having a lower thermal
10 expansion coefficient than that of a material of the valve body,
11 the spool and the cylinder defining a pressure chamber and a
12 space portion;
 - 13 an urging member disposed in the space portion to urge
14 the spool in a direction opposite to a direction of a force
15 applied to the spool by fluid pressure in the pressure chamber;
 - 16 a through-passage formed in the spool so as to fluidly
17 communicate the pressure chamber and the space portion; and
18 an orifice disposed between the space portion and a
19 sump to limit a flow rate of fluid drained from the space
20 portion to the sump.
- 1 2. The pressure regulating valve as claimed in claim 1,
2 wherein a flow rate of fluid, which flows from the pressure
3 chamber to the space portion through the clearance and the
4 through-passage, increases according to the increase of a
5 temperature of the fluid.

1 3. The pressure regulating valve as claimed in claim 2,
2 wherein the clearance is increased according to the increase of
3 the fluid temperature.

1 4. The pressure regulating valve as claimed in claim 1,
2 wherein a port of the supply passage to the pressure chamber
3 is always fully open, and the spool intermittently closes a port
4 of the drain passage to the pressure chamber.

1 5. The pressure regulating valve as claimed in claim 1,
2 wherein
3 a flow rate of fluid flowing from the pressure chamber to
4 the space portion is less than a flow rate of the orifice when
5 under a low temperature condition,
6 a flow rate of fluid flowing from the pressure chamber to
7 the space portion is more than a flow rate of the orifice when
8 under a high temperature condition.

1 6. The pressure regulating valve as claimed in claim 1,
2 wherein
3 an amount of fluid flowing from the clearance and the
4 through-passage into the space portion is less than an amount
5 of fluid flowing through the orifice when fluid temperature is
6 low,
7 an amount of fluid flowing from the clearance and the
8 through-passage into the space portion is more than an
9 amount of fluid flowing through the orifice when fluid
10 temperature is high.

1 7. The pressure regulating valve as claimed in claim 1,
2 wherein the spool comprises a plurality of lands, the through-
3 passage being formed in a land of the spool.

1 8. The pressure regulating valve as claimed in claim 3,
2 wherein the spool and the orifice are made of steel, and the
3 valve body is made of aluminum.

1 9. The pressure regulating valve as claimed in claim 1,
2 wherein the clearance is formed between an inner
3 circumference of the cylinder and an outer circumference of the
4 spool.

1 10. The pressure regulating valve as claimed in claim 7,
2 wherein the clearance is formed between the inner
3 circumference of the cylinder and an outer circumference of the
4 land in which the through-passage is formed.

1 11. The pressure regulating valve as claimed in claim 1,
2 wherein fluid pressure from the supply passage is fed back to
3 urge the spool in one direction via a branch passage, the
4 branch passage comprising an orifice.

1 12. The pressure regulating valve as claimed in claim 1,
2 wherein a flow rate F_T of the through-passage, a flow rate F_C of
3 the clearance, and a flow rate F_O of the orifice exist in a
4 relationship under a lower temperature condition where the
5 expression $F_O > F_T + F_C$ is satisfied, and exist in a

6 relationship under a higher temperature condition where the
7 expression $F_0 < F_T + F_C$ is satisfied.

1 13. The pressure regulating valve as claimed in claim 1,
2 wherein the spool is forced to slide and unblock the drain
3 passage when fluid pressure of the pressure chamber has risen
4 above a preset target value, thereby maintaining fluid pressure
5 of the pressure chamber at the target value.

1 14. A pressure regulating valve comprising:
2 a valve body;
3 a bore formed in the valve body, the bore comprising a
4 space portion, a first pressure chamber, and a second pressure
5 chamber;
6 a spool which is slidably inserted within the bore, a
7 diameter of an inner circumference of the bore being greater
8 than a diameter of an outer circumference of the spool so as to
9 form a clearance, the first pressure chamber thereby being in
10 hydraulic communication with the space portion, a material of
11 the spool having a lower thermal expansion coefficient than a
12 material of the valve body;
13 a supply passage through which hydraulic pressure is
14 supplied to the first pressure chamber from a pressure supply
15 source;
16 a drain passage through which hydraulic pressure is
17 drainable from the first pressure chamber;
18 a through-passage being formed in the spool through
19 which the space portion and the first pressure chamber are in
20 hydraulic communication; and

21 an urging member which is disposed in the space portion
22 to apply an urging force to the spool;

23 wherein hydraulic pressure in the second pressure
24 chamber pushes the spool to allow draining of hydraulic
25 pressure when hydraulic pressure in the first pressure chamber
26 has risen above a target hydraulic pressure,

27 the draining continuing until an equilibrium is reached
28 between the urging force of the urging member and an
29 opposing urging force of hydraulic pressure in the second
30 pressure chamber.

1 15. The pressure regulating valve as claimed in claim 14,
2 wherein the spool comprises a plurality of large diameter
3 portions, the through-passage being formed in a large diameter
4 portion which is disposed between the space portion and the
5 first pressure chamber.

1 16. A pressure regulator valve of an automatic transmission,
2 the pressure regulator valve comprising:

3 a valve body which comprises

4 a cylinder,

5 a supply passage which hydraulically connects the
6 cylinder and a pressure supply source,

7 a drain passage which hydraulically connects the
8 cylinder and a sump, and

9 an inflow-outflow passage which hydraulically
10 connects the cylinder and the sump;

11 a spool which is slidably inserted within the cylinder, the
12 spool dividing the cylinder into at least one space portion

13 hydraulically connected to the inflow-outflow passage, a first
14 pressure chamber receiving pressure from the supply passage,
15 and a second pressure chamber receiving pressure from the
16 supply passage, a material of the spool having a lower thermal
17 expansion coefficient than a material of the valve body;

18 urging means for applying an urging force on the spool in
19 a direction opposed to an urging force of the second pressure
20 chamber, the spool sliding to allow excess pressure to drain
21 when hydraulic pressure of the second pressure chamber
22 overcomes the urging force of the urging means;

23 a clearance through which fluid flows from the first
24 pressure chamber into the space portion;

25 a through-passage through which fluid flows from the first
26 pressure chamber into the space portion, the through-passage
27 being formed in the spool; and

28 restricting means for restricting the flow rate of the
29 inflow-outflow passage,

30 the flow rate of the restricting means being less than a
31 combined flow rate of the through-passage and the clearance
32 under a low temperature condition,

33 the flow rate of the restricting means being more than a
34 combined flow rate of the through-passage and the clearance
35 under a high temperature condition.